The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

In re: Lake Waukewan
Center Harbor, Meredith and
New Hampton, NH

NOTICE OF DECISION
INTERIM OPERATING LEVEL

BACKGROUND

On August 25, 2008, the Department of Environmental Services (DES) received a citizen complaint about high water for Lake Waukewan which is controlled by the Lake Waukewan Dam (Dam No. 155.01). Additional comments concerning high water on Lake Waukewan and Lake Winona were also received. In addition, DES received a letter dated September 30, 2008 from the Lake Winona Improvement Association concerning high water levels on the lakes. In response to these citizen concerns and comments, DES began an informal investigation of conditions affecting the use and enjoyment of the lakes

Lake Winona flows into the Snake River and subsequently into Lake Waukewan. As there is no dam at the outlet of Lake Winona and because the section of the Snake River between the two water bodies is both very flat and shallow, the water level in Lake Winona is heavily influenced, if not controlled, by the water level on Lake Waukewan. The water level in Lake Winona is further affected by the limited discharge capacity of the bridge/culvert that exists under Winona Road, especially after significant rainfall events. Beaver activity on the Snake River, which is a recurring problem, may also influence the water level on Lake Winona. Continued local management of beaver activity in this area will reduce the impact that it has on the level of Lake Winona.

The water level on Lake Waukewan is controlled by the Lake Waukewan Dam. In recent years, decisions concerning operations at the dam were made by or in conjunction with the Town of Meredith, but the adjustments to the dam were made by the dam owner, Hampshire Hospitality Holdings. In DES's discussions with the Town of Meredith, the Town indicated that operating decisions were made based on maintaining a lake level of elevation 540 plus several inches, and that the existence of or needs associated with the Town-owned water treatment facility on the southeastern end of Lake Waukewan were not considerations in making those decisions. No formal Operation, Maintenance and Response plan currently exists for the dam. The dam owner did not have a preference for the operating level for Lake Waukewan and expressed a desire to cooperate with DES in determining the best water level for all concerned.

The initial concerns expressed to DES included high water and potential problems with shoreline property use and damage, as well as concerns about loon nesting and water quality. These initial comments

occurred soon after a significant precipitation event that the area experienced in August 2008. Further, several other large storms had occurred in the previous few years. Additional concerns that were expressed later in the investigation included the potential effects of lower water levels, property use, recreation, loon nesting and water quality.

The water levels that are maintained in the state's lakes and ponds impact many private and public interests. Some interests may favor lower water levels, while others may be enhanced by higher levels. Some interests are relatively unaffected by varying water levels, while others are dependent upon the circumstances specific to particular land features or the specific needs or desires of the individual property owners that surround the water body. The verbal testimony received at the public meetings, the many written comments gathered over the past 18 months, the results of the water level survey and the findings of the investigations conducted by DES all reveal that there are real and perceived benefits and disadvantages to any operating schemes. DES, after considering the myriad of water uses and impacts that water levels have on all of the interests investigated, is charged with formulating a recommended water management scheme that weighs each issue appropriately.

The investigation was performed with a broad spectrum of public input and involvement and considered a wide and varied array of issues pertinent to the effects of water management at both lakes. The intent of the investigation was to perform a preliminary, yet detailed, evaluation of the pertinent issues and, if conditions supported it, direct the dam owner to modify past dam management practices to effect reasonable changes that would be the basis of an interim operating plan. During the course of this investigation, DES heard from numerous citizens concerned about the lake levels and potential changes in the lake levels. The comments could generally be summarized into two groups, a group who was concerned about recent high water levels and a group who was concerned with future potentially lower water levels. Given the diversity of opinions on the management of the water level for Lake Waukewan and Lake Winona, DES is issuing this decision establishing the interim operating level for Lake Waukewan, which is based on DES's consideration of all of the interests associated with the management of water levels. This interim operating level will be implemented for the 2010 recreation season. During the 2010 recreational season DES will solicit public comments on this interim operating level, after which, DES will issue a final decision regarding the operating level of Lake Waukewan.

ANALYSIS

As part of the investigation DES evaluated information from a number of sources. These included:

- Review of the DES files for the dam and other public information, including
  - FEMA Flood Insurance Rate Maps
  - Water Level Data
- Analysis of the hydrology and hydraulics of the watershed and the Lake Waukewan Dam to evaluate the water levels for both lakes under normal conditions and during significant storms.
- Field reconnaissance by land and water
- Comments on historical water levels and potential issues related to changes in water level received from the following:
  - NH Department of Environmental Services
    - Drinking Water and Groundwater Bureau
    - Watershed Management Bureau
  - NH Department of Fish & Game
  - NH Department of Safety's Marine Patrol

- The Loon Preservation Committee.
- Dam Owner, Hampshire Hospitality Holdings, Inc.
- Town of Meredith
- Two public information meetings
- A survey of opinions from lake residents and other users

FINDINGS

FILE AND PUBLIC INFORMATION REVIEW

Documents Governing the Level of Lake Waukewan

- A 1904 decision by Belknap Superior Court in Whittemore vs. Jones, & a (Decree in Equity 1160) provides limits on the opening and closing of the gate for mill operation on the "Main Street dam" for the purpose of operating the Meredith Linen Mill. The "Main Street dam" was located east of and adjacent to Main Street. The decree does not provide elevations for the various portions of the dam and only provides measurements from the benchmark referenced in the decree. The "Main Street dam" and the elevation monument referenced by the decree could not be found, and, based on DES's research and field work, they appear to no longer exist. However, based on this decree, the 1889 Sanborn Fire Insurance Map and other historical information, the existing canal, inlet, penstock and surge tower (headhouse) appear to be substantially the same as those that existed in the late 1800s and early 1900s. It should be noted that, because the elevation of the benchmark used to establish the elevation of the top of the two feet of flashboards at the headhouse was not noted in the decree, the decree in and of itself cannot be used to determine the intended water level for Lake Waukewan. It is the belief of DES that the headhouse mentioned in the decree refers to the surge tower that existed at that time, and that the flashboards acted to raise the water level of Lake Waukewan two feet above the permanent crest of the surge tower.

  The decree did provide gate closing and opening criteria for operation of the mill, specifically stating that the owner *"has the right to wholly or partially close the gates of said Main Street dam whenever the water is not high enough to run over said two feet of flash boards with said gates open and to keep said gates closed so long as the water does not rise above the height just described. The (owner) has no right to wholly or partially close said gates or keep them closed at any time when the water is above said height". "Said height"* being identified as the top of the two feet of flashboards previously discussed. In short, when the water level was below the top of the flashboards, the owner could open and close gates at the owner's discretion, but when the water was above the top of the flashboards, the gates had to be fully open. It should be noted that the gates referenced in the decree no longer exist, but records at DES indicate that their combined discharge capacity was approximately 100 cubic feet per second (cfs).

- The New Hampshire Water Resources Board, the predecessor agency to DES, issued a "Report upon Flood Conditions at Meredith Caused by High Water in Lake Waukewan" in 1936. This report evaluated the March 1936 flooding event that overflowed the lip of Lake Waukewan and partially flooded the Town of Meredith. This report included elevations for the monument and other features referenced in the 1904 decree including the permanent spillway crest and the top of the boards in the surge tower. The report indicates that these elevations were based on a United States Geological Survey (USGS) datum, but does not provide any additional information on the standards or techniques used in surveying the dam components and the elevation benchmark

referenced in the 1904 decree. At the time of this 1936 report, the elevation of the permanent crest of the surge tower was given as 538.70 feet and the elevation of the top of flashboards was given as 540.70 feet, corresponding to the two feet of flashboards as provided for in the 1904 decree. On September 15, 2008, DES personnel surveyed the major components of the dam and measured the elevation of the top of flashboards to be at elevation 540.69 feet (NGVD 1929). Therefore, it is the opinion of DES that, based upon file photographs and the limited modifications that have occurred to the dam since 1936, the elevations provided in the 1936 report correspond to those intended by the 1904 court decree, and that the 2008 survey data can be taken to reflect the same elevation references.

Past Modifications to the Dam

- DES's files indicate that no power was generated at the dam after 1954, and that the gates used to supply water to the turbine were removed and the inlet permanently blocked in about September 1976. The blockage of these gates, as noted above, reduced the dam's discharge capacity by approximately 100 cfs. At the suggestion of the Water Resources Board, the owner lowered the permanent spillway crest of the surge tower by approximately 18 inches in the late 70's in order to compensate for the discharge capacity lost by the closure of the gates and removal of the turbine. In January 1983, the permanent spillway crest of the surge tower was reportedly lowered an additional 6 inches to compensate for discharge capacity lost as the result of modifications (reduced diameter caused by re-lining) to the steel penstock leading to the surge tower. Based on these reported modifications, the permanent spillway crest should be 536.7; however, the permanent spillway crest was surveyed on September 15, 2008 as 537.32. This could indicate that either the second spillway lowering did not take place as planned, or that an error was made in measurements during the work.

Past Documentation of the Water Level at Lake Waukewan

- The 1927, 1940 and 1956 USGS Topographic Quadrangle Maps show a surface elevation of 539 for Lake Waukewan and 540 for Lake Winona. The 1987 USGS Topographic Quadrangle Map shows a surface elevation of 540 for both Lake Waukewan and Lake Winona. At least eight references to a normal or typical water level of elevation 539 for Lake Waukewan were identified in DES's files over the time frame of 1939 to 2001, typically on dam data sheets, operations guides, calculation sheets, drawings or letters. In addition, the Official List of Public Waters maintained by DES lists the Approximate Water Surface Elevation of Lake Winona as 540.0 and Lake Waukewan as 539.0. There is no survey information in the files for these lakes, and it is likely that the elevations in the files, as well as the elevations in the Official List of Public Waters, were taken from the USGS topographic maps and were not based on actual surveys.

- The 1978 Army Corps of Engineers (ACOE) Phase I Inspection Report identified the normal water level of Lake Waukewan to be elevation 539, and indicated that there was a 15 to 22 inch lowering of the water level each fall. The survey information in this report indicates a lake level elevation of 539.6 on June 5, 1978 with 3 boards in place in each of the three stoplog bays and about 6 inches of water flowing over the top of boards.

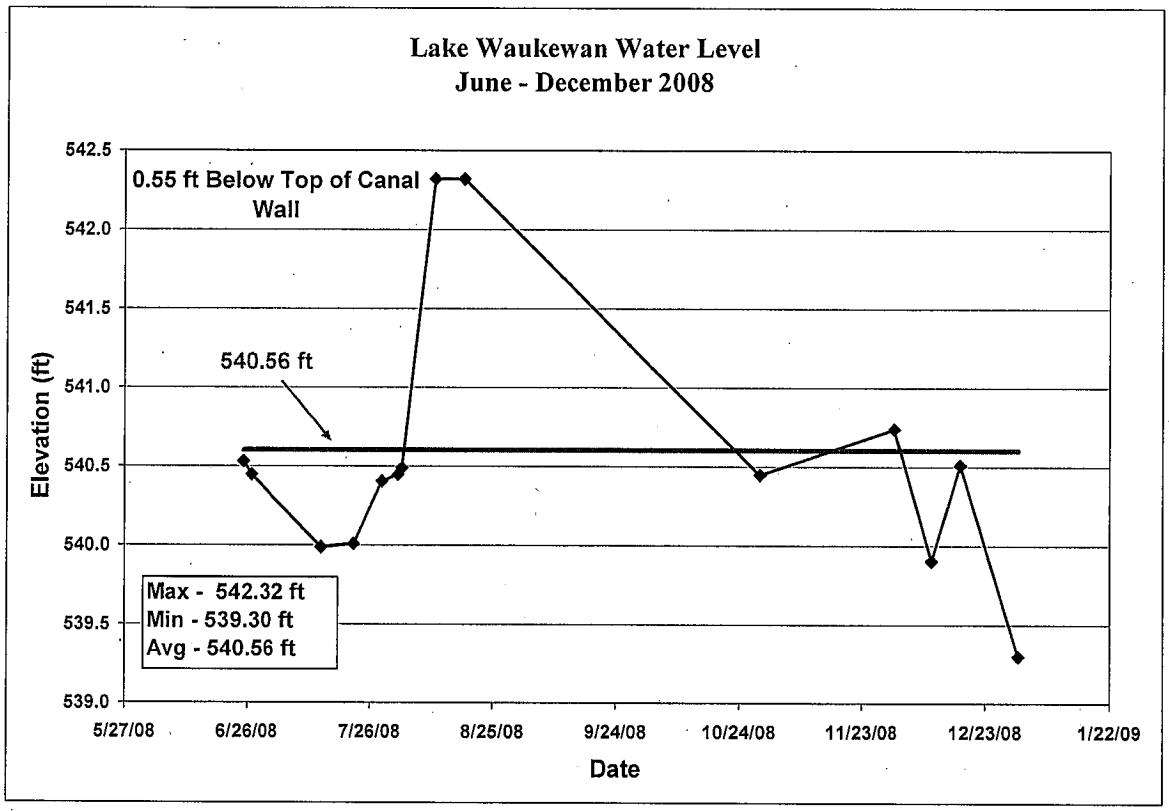
Evidence of Water Levels at Lake Waukewan over the Past Twenty-Five Years

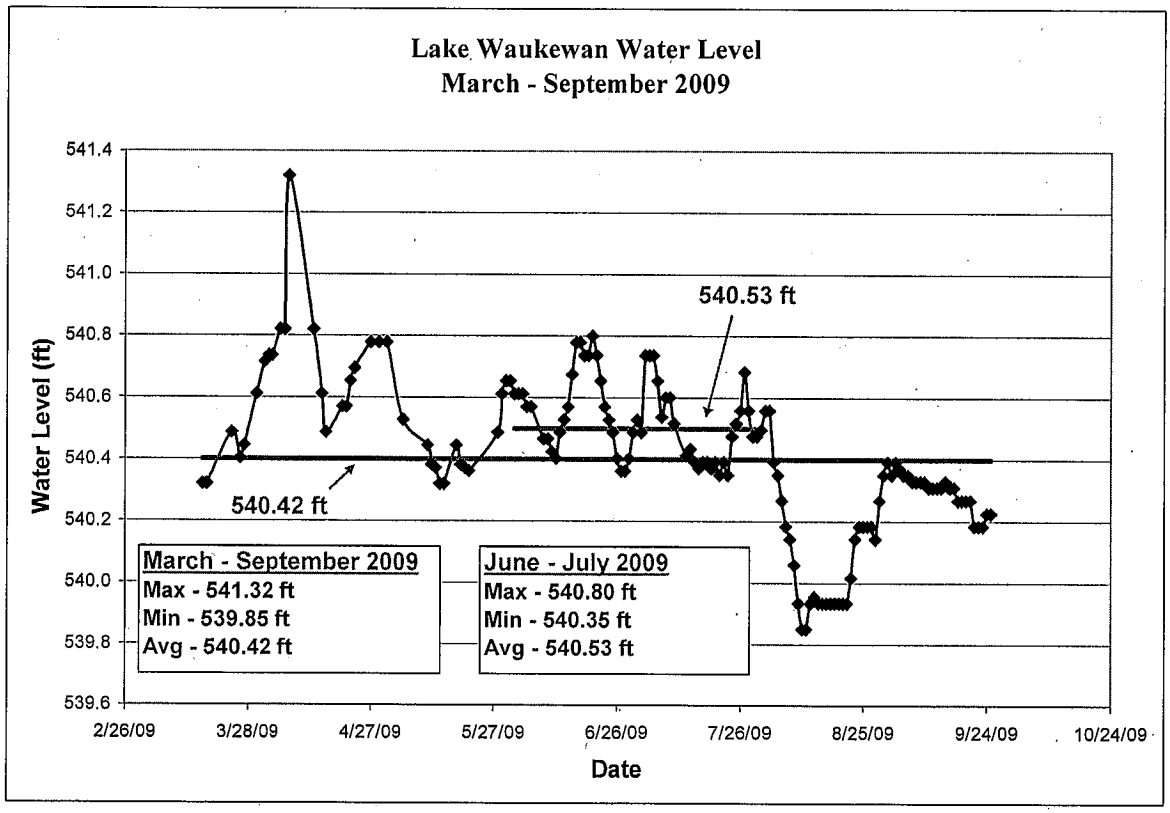
- Photographs (12) in DES's files, which show the surge tower after 1982, were reviewed to evaluate the number of boards in place, the approximate elevation of the boards and the approximate water elevation shown. The estimated elevations of the boards and water level on each occasion were determined assuming a permanent crest elevation of 537.32 and a height of 6.7

inches for each board. The table below summarizes the information found for the dates indicated:

	Boards		Estimated Water Surface		
Date	No. (I-II-III)	Elevation (ft)	Over Boards (inch)	Elevation (ft)	Note
March 1983	4-4-4	539.5	6	540.0	HW mark 540.6 ft
June 1984	4-4-4	539.5	6	540.0	
July 1985	5-4-5	540.1/539.5	4 over II only	539.8	
March 1988	4-4-3	539.5/538.9	6 over II & III	540.0	
May 1991	3-3-3	538.9	6	539.4	
June 1996	5-5-5	540.1	No Flow	< 540.1	
November 2000	4-4-4	539.5	No Flow	< 539.5	
January 2002	4-4-4	539.5	No Flow	< 539.5	
September 2004	5-5-5	540.1	1	540.2	
June 2006	4-4-4	539.5	6	540.0	Short Board in II
May 2007	6-5-5	540.6/540.1	2 over II & III only	540.6	
June 2007	5-5-5	540.1	4	540.4	Short Board in II
September 2008	3-6-6	538.9/540.6	16 over I only	540.2	Short Board in II
October 2008	4-4-4	539.5	10	540.3	
November 2008	4-4-4	549.5	10	540.3	

- Water levels measured by the Town of Meredith Water Department were available for June through December 2008 and March through September 2009 and graphical plots of these data are included below:


Lake Waukewan Water Level
June - December 2008
542.5
542.0
541.5
541.0
540.5
540.0
539.5
539.0
Elevation (ft)
0.55 ft Below Top of Canal Wall
540.56 ft
Max - 542.32 ft
Min - 539.30 ft
Avg - 540.56 ft
5/27/08
6/26/08
7/26/08
8/25/08
9/24/08
10/24/08
11/23/08
12/23/08
1/22/09
Date


Lake Waukewan Water Level
March - September 2009
541.4
541.2
541.0
540.8
540.6
540.4
540.2
540.0
539.8
539.6
Water Level (ft)
540.53 ft
540.42 ft
March - September 2009
Max - 541.32 ft
Min - 539.85 ft
Avg - 540.42 ft
June - July 2009
Max - 540.80 ft
Min - 540.35 ft
Avg - 540.53 ft
2/26/09
3/28/09
4/27/09
5/27/09
6/26/09
7/26/09
8/25/09
9/24/09
10/24/09
Date

- On August 8, 2008, DES personnel, who were performing dam observations after heavy rainfall the previous day, recorded a level of 2.6 at the staff gage in the canal that supplies the steel penstock. Based on a survey performed by DES, this staff gage reading corresponds to a water level elevation of 540.5. The number of boards in place at the surge tower was not known and could not be observed in the field due to the high water flows. Based on gage readings, Lake Waukewan peaked for this event at 542.32 between August 11 and August 18, 2008. It should be noted that the water was overtopping the left flume wall adjacent to the outdoor restaurant seating at this time, indicating a significant discharge rate from the surge tower.
- Based on the available information, summer water levels appear to have consistently been maintained at or above elevation 540 for the past two to three decades. Further, it appears that in recent years, as documented in the table above, in the attached Water Level Graphs and from discussions with the dam owner, representatives from the Town of Meredith and shore residents, the water level has been maintained nearer an average elevation of 540.5 during the recreation season.

FEMA Flood Insurance Maps

- The eastern portion of Lake Waukewan and surrounding area are covered in FEMA Panel 3300060010B effective June 3, 1988, and a 100-year flood elevation of 544 is provided for Lake Waukewan. The western portion of Lake Waukewan and the southern portions of Lake Winona and Snake River are covered by FEMA Panel 330007B effective April 2, 1986, however, no elevations are provided on this panel. The northern portion of Lake Winona and the Snake River are unmapped by FEMA flood maps.

HYDROLOGY AND HYDRAULIC ANALYSIS

Water Level Needed to Pass Inflow Design Flood

- As a part of this investigation, DES performed a hydraulic and hydrologic evaluation of the dam and its watershed. The evaluation was performed for the 100-year flood and the 2.5 x 100-year flood for starting elevations of both 539 and 540. The 100-year flood resulted in an inflow of 4,130 cfs and the 2.5 x 100-year flood resulted in an inflow of 10,325 cfs. The peak routed outflow and corresponding elevations are provide below:

  (a) 100-year flood

    (i) 539 foot starting elevation - 92 cfs peak outflow at an elevation of 540.8 feet with 2.3 feet of freeboard remaining before the canal walls upstream of the penstock inlet are overtopped.

    (ii) 540 foot starting elevation - 92 cfs peak outflow at an elevation of 541.8 feet with 1.3 feet of freeboard remaining before the canal walls upstream of the penstock inlet are overtopped

  (b) 2.5 x 100-year flood

    (i) 539 foot starting elevation - 260 cfs peak outflow at an elevation of 543.4 feet with 0.3 feet overtopping the canal walls upstream of the penstock inlet

    (ii) 540 foot starting elevation - 420 cfs peak outflow at an elevation of 543.8 feet

with 0.7 feet overtopping the canal walls upstream of the penstock inlet

- Paragraph Env-Wr 303.11 of New Hampshire's Dam Safety Rules requires that Lake Waukewan Dam, a High Hazard dam, have adequate discharge capacity to pass the 2.5 x 100-year flood or the site specific Inflow Design Flood (IDF), whichever is most appropriate based upon the hazards posed by a failure of the dam. The dam must be able to pass the appropriate flood flow without manual operations and with at least one foot of freeboard remaining before dam overtopping occurs. Based on the analysis summarized above, this dam is not capable of passing the 2.5 x 100-year flood with 1-foot of freeboard and therefore the IDF for this dam was evaluated.

  The IDF is defined by Env-Wr 101.23 as the "flood flow above which dam failure would not contribute to endangering public safety or property downstream of the dam". A review of the downstream hazards for this dam found that the portions of the Mill Falls complex below the dam, on both sides of the channel, and NH Route 3 would be impacted by a failure of the dam (assumed to be a failure of the penstock, surge tower or flume channel that directs water away from the surge tower). The breach simulations indicated that, regardless of the meteorological event occurring in the watershed, the breach flow for both the 100-year and 2.5 x 100-year floods is within about 25% due to the flow limitations caused by the restrictions imposed by the narrow inlet canal and penstock. Therefore, as there is no added consequence to failure under the 2.5 x 100-year flood conditions, the 100-year flood is considered to be the IDF for this dam. As noted above, the dam is capable of passing the IDF with the minimum amount of one foot of freeboard provided that the initial lake level is at elevation 540.4 or lower.

  Due to the limited discharge capacity of the dam, the majority of the rainfall runoff is stored in the lake, resulting in water levels higher than the target level during normal or greater than normal rainfall patterns. In practice, unless meteorological conditions have been relatively dry for an extended period, maintaining an elevation that does not fall below 540.4 will most likely result in one that averages 2 to 4 inches higher than 540.4. This condition leads to a higher frequency of instances when the starting elevation will be higher than the maximum elevation that still allows the dam to safely pass the IDF storm. As such, the lake level should be targeted at an elevation lower than 540.4 to both allow for a buffer for higher water levels, which may exist prior to the IDF storm, and to keep peak flood levels below elevations that may cause significant economic damages.

Estimated Water Level during Spring and Summer

- In an effort to evaluate normal recreational (May through September) and spring melt (March and April) flows for the Lake Waukewan watershed, five USGS stream gages on watersheds of similar size (8.95 to 58.8 sq mi) located in New Hampshire and Vermont were analyzed. These flows were then adjusted for watershed size, resulting in an estimated average daily inflow of about 21 cfs during the recreational months and an average daily spring melt flow of about 64 cfs. These flows were routed through the penstock/surge tower, assuming no manual operations (stoplog removal) were made to the dam, resulting in flow depths of 0.6 feet and 1.4 feet. This analysis addresses average daily flows for the periods analyzed and does not account for the typical intense, short duration storms experienced in recent years. In reality, inflows do not occur in such an equalized manner. These types of events will produce average daily inflows of a much larger scale, with correspondingly higher peak event stages.

FIELD RECONNAISSANCE BY LAND AND WATER

- Numerous field reconnaissance visits were made to the Lake Waukewan Dam, Lake Waukewan boat ramp, Waukewan Road bridge, Winona Road bridge, portions of the shoreline accessible by land and other key location within the watershed over the course of this investigation to make observations and measurements of water levels and key features. The information gathered was utilized in the hydrology and hydraulics models and in evaluating impacts from high water levels and potential impacts from lowered water levels.

- DES crews surveyed key components of the Lake Waukewan Dam, Lake Waukewan boat ramp, Waukewan Road bridge and Winona Road bridge on September 15, 2008, May 4, 2009 and October 22, 2009. Temporary benchmarks were placed at the Waukewan and Winona Road bridges. An electronic lake level measuring gage and a staff gage were placed in the canal leading to the Lake Waukewan Dam on October 22, 2009.

- Field reconnaissance by water was performed by DES staff of the shoreline of Lake Winona and the Snake River on September 23, 2008 and of Lake Waukewan, Lake Winona and the Snake River on October 5, 2009 to identify and document those physical features that provided the best available evidence of recent and historical water levels.

COMMENTS ON HISTORICAL WATER LEVELS AND POTENTIAL ISSUES RELATED TO CHANGES IN WATER LEVEL

Shoreline Damage and Property Use

- The nature and topography of the shorelines around both Lake Waukewan and Lake Winona vary. Both water bodies include areas of natural features as well as areas that are developed to differing degrees. Though much of the development of homes, cottages and appurtenant structures is well above elevation 540 and the normal fluctuation of water levels that has occurred in the past, there are a fair number of properties where either inhabited structures and/or man-made features associated with shoreline properties are routinely affected by high water levels. Most, if not all of the structures with frequent impacts are neither new nor illegally built. Further, artificially elevated lake levels, prevalent at times of high wind or during the summer months when motorized recreation is occurring, exacerbate damage to the shoreline and its vegetation, as well as to property.

- Lakefront properties and shoreline vegetation, including trees, bushes, grasses and other plants, will be subjected to the effects caused by the rise and fall of the water level, either due to the normal maintenance of water levels by the dam, periodic fluctuations due to dry or wet conditions, wave action due to boat traffic or wind, the influence of groundwater and the formation and effects of ice. Over time, and with a relatively constant set of operating conditions, the shoreline is likely to reach a form of balance in response to these conditions. This is not to say that at some point detrimental effects cease to occur, only that the effects may be anticipated, better defined and localized to an area of known influence. The variable nature of the lake levels at both Waukewan and Winona, as experienced over the past few decades, has subjected a relatively broad band of the shorelines to these forces.

  As conditions change, especially those that result in higher water levels that are of longer durations (seasonal), the response of the shoreline will change as well. Additional erosion of the natural

shore, undercutting, inundation and saturation of root systems, damage to buildings and other man-made structures and changes or restrictions to recreational pursuits (docks, beaches, etc...) may be experienced.

Water Quality

- Septic systems (tanks and leach fields) may be adding to the nutrient and contaminant load of the lakes, either by direct contact with surface waters or by connection to groundwater caused by high water levels. Potential causes for such contamination, if occurring, may relate to failed or improperly installed systems; or systems that are experiencing conditions or stresses that they were not designed to address. The Town of Meredith released a Septic Risk Analysis on October 2, 2009 for septic systems within their corporate boundary that were potentially impacting Lake Waukewan. This analysis indicated that 48% of the septic systems within 250 feet of the lake or its major tributaries pose a Very High or High risk to the water quality of Lake Waukewan. No analyses or studies of septic systems for the remainder of Lake Waukewan or Lake Winona or the Snake River were discovered.
- The Town of Meredith maintains a fresh water intake and water treatment facility at the southern end of Lake Waukewan. According to information received from Meredith Water Deptartment personnel, the water intake pipe extends approximately 1,700 feet into the lake, and the inlet end is approximately 20 to 22 feet below the normal water surface elevation. The only issue of concern, which has yet to be explored or analyzed by the Town, is the depth of cover over the pipe as it nears the shoreline. Otherwise, water level variations do not pose a quantity or quality concern for the treatment facility.
- While every watershed and lake system is unique, in general, lower water levels result in limited improvements in water quality compared to higher water levels. Lower water levels typically reduce shoreline erosion and nutrient runoff. Lower phosphorus runoff typically reduces formation of cyanobacteria blooms. Lower water levels may increase the quantity of shallow vegetation; this would not typically result in a negative impact to the health of the lake as long as the vegetation is native and not invasive.

Fisheries and Wildlife

- Fisheries that currently exist in the Lake Winona/Lake Waukewan system are not expected to be affected by relatively small adjustments to lake level. Natural species include bass, pickerel, perch and smelt, among others; and the NH Fish & Game Department stocks rainbow trout annually. Spring spawning is anticipated to be unaffected by small water level variations, and fall spawning issues reportedly do not exist – as there are no lake trout and the stocked rainbow population is small and artificially managed.
- Loon nesting has occurred in Jenness Cove (floating nesting rafts) and, sporadically, on the Snake River between Winona Road and Waukewan Road. Though water heights do not affect the viability of floating raft nests, water level variations may be acting to alternately expose and submerge whatever natural hummocks may exist in the Snake River. According to the Loon Preservation Committee, there is a potential that lower water in this area may increase the potential for the Snake River habitat to see nesting though no formal or detailed surveys of this area have been completed to better quantify the effects of these variations on successful nesting, Successful nesting in natural areas has more to do with minimizing the degree of water level fluctuation during the nesting period than does the absolute elevation of the water.

Recreation

- The potential effect on motorized recreation on the lakes has been raised as a concern, especially if levels are reduced appreciably. Specific issues include increased navigational hazards, use of the public boat launches, access to docks and shoreline properties and access to existing shallow areas of the lakes. Based on the information available, the water levels of both lakes have been significantly lower over the majority of the history of the dam controlling them. Given the history of water level fluctuations on the lakes, it is reasonable to determine that recreational boating and other activities on the lakes have always been possible, and DES would not expect the exercise of such pursuits to be appreciably lessened by moderately lower lake levels. DES recognizes that changes to boat ramps, docks and other water related structures may be needed; however, changes to such structures were also required when water levels were adjusted in the past. DES also understands that several hazard markers have been submerged with the higher water levels recently maintained. These markers may be repaired by the Marine Patrol and/or additional markers placed, if required, by any change in water levels.
- Observations made at the Town of Meredith public swimming area (Waukewan Beach) at the southern end of Lake Waukewan reveal a very narrow strip of sand at lake levels at or above elevation 540.5. Use of the facility is extremely limited, with one end of the beach measuring only about 8 feet from the concrete retaining wall to the edge of water.

Flood Control

- Flood control was raised as a primary concern and an important goal of any future operating scheme by the majority of residents who testified at the public meetings and who responded to the Lake Level Survey. Achieving an appropriate measure of flood control, while at the same time exercising an operating scheme that allows for water levels that provide for other management goals can be a challenge. Spring flooding may be easiest to address by conducting an extreme fall lowering of the lake, but a fall drawdown would not provide relief for events that occur at other times of the year like the one experienced in August of 2008. Evaluating past events in terms of the capabilities of the existing dam to address them shows that intense summer storms can result in rapid rises in water levels followed by very slow reductions. The period between the peak level and the time that the lake returns to "normal" is one where the lake is susceptible to the potential for flooding if additional rainfall events occur. As previously discussed in the Hydrology and Hydraulics Analysis above, establishing an adequate buffer to provide additional storage and the necessary freeboard is especially prudent for this dam due to its limited discharge capacity relative to potential inflows. Sequential storm events are the most problematic for this system.
- Drawdowns, or drops in the water level each fall, can be instrumental in protecting both the shoreline and shoreline structures from the ravages of ice and wind-induced waves. Further, the additional storage created provides for the attenuation of spring runoff flows resultant from snow melt and precipitation on already saturated soils.

CONCLUSIONS

The current configuration of the Lake Waukewan Dam differs significantly from how it existed at the time of the 1904 decree, and its ability to be efficiently operated to conform to the terms of the decree has been lessened. The elimination of the low level gates and the inherent difficulty of managing dam discharges using only stoplogs do not allow dam operations to be made as intended by the decree. Further, present-day management of Lake Waukewan in accordance with the upper limits established as part of the

decree would neither serve the purposes intended (surplus storage for mill operations) nor the needs that exist in the watershed. Hampshire Hospitality Holdings, Inc., though an arguably legal holder of these rights, has expressed both an interest and willingness to establish an operational protocol that provides an added measure of dam safety, reduces instances of reservoir flooding and supports the best interests of the watershed, as a whole.

Records at DES show that water levels, and the public's opinion of them, have varied widely in the last 110+ years. The 1904 decree was the result of dissatisfaction on the part of the then abutters (both Waukewan and Winona) relative to the dam owner's excessive storage (high water and associated property damage) for mill uses, and there have been several instances of significant flooding since that time, including periods in 1936, 1954, 1973, 1998 and 2008. Conversely, beginning in 1938, the file contains several instances of complaints from lake abutters decrying the dam owner's excessive use of stored water, in some cases seeing the lakes drop up to 5 or 6 feet over the course of the summer. Pertinent dates for low water complaints were 1938, 1949 and 1958. The files contain almost no record of low water complaints from the mid to late 50's when the hydroelectric machinery was reported to have been shut down, though there are indications that process water was used by the various manufacturing businesses that occupied the former buildings at the Inn at Mill Falls complex. This assumption is supported by the oral and written testimony received that indicated memories of a slow lowering of the water levels over the course of most recreational seasons through the decades of the 60's and 70's.

When the last major manufacturer (Amatex Corp.) closed down in 1983, operations at the dam shifted from the dual purpose of mill operations and recreation to strictly recreation. This most likely effectively put an end to lowering summer levels and the goal became to loosely manage levels at or near elevation 540.0. Since no formal records have been produced that show a continuous log of actual lake levels, the only supporting information comes from the dam owner and other local contacts. At some point between 1983 and today, management decisions were made that acted to raise that level so that summer pool levels averaged closer to 540.5. These higher levels are, in fact, supported by a fairly good record of lake levels that exist for both 2008 and 2009.

Based upon DES's research, investigative efforts and findings to date, DES concludes the following:

- The operating level of Lake Winona is directly influenced by the capacity of the culvert that passes under Winona Road, the management of the Lake Waukewan Dam and, more recently, the activity of beavers in the reach of the Snake River between Winona Road and Waukewan Road.

- The 1904 decree, absent subsequent official instruments requiring dam or water management policies to the contrary, is considered to be representative of the current dam owner's rights associated with flowage. No other documents were found or otherwise produced during the course of DES's assessment that indicated the existence of any other rights associated with the management of water levels at either Waukewan or Winona lakes.

- The top of flashboard elevation referenced in the 1904 decree, as defined in the 1936 flood report, is considered to be elevation 540.70. This elevation reference and those from the 2008 survey are considered to be based upon the same elevation datum, thereby establishing this elevation as a trigger point for dam operations on the part of the dam owner.

- In accordance with the 1904 decree, a minimum of 100 cfs should be discharged from the dam at any time that the water level of Lake Waukewan exceeds elevation 540.70. Adherence to this

minimum discharge requirement, especially when considering the removal of the turbine and closure of the low level outlet, has not occurred with any regularity for the past two or three decades, nor was it likely operationally achievable.

- The water level management practices in the last 25 years or so appear to have resulted in the level of Lake Waukewan being managed, under normal or average inflow conditions, both higher and lower than elevation 540.0 with elevations greater than 540.7 during periods of high inflow, but that conscious decisions have been made in recent years to increase water levels.

- The 100-year flood event is considered the IDF (inflow design flood) for Lake Waukewan Dam. That is, the dam must be able to pass the runoff produced by this event, without manual operation, with at least one foot of freeboard remaining. The major components of the dam (canal and surge tower) meet these criteria and, therefore, the dam is considered to be in compliance with Env-Wr 303.11(a)(3). However, the flume below the surge tower does not appear to have one foot of freeboard during high flows. Additional information relative to the flume (dimensions, wall stability, etc.) will be requested as a part of DES's report on the routine inspection performed in 2009, and the freeboard in the flume will be evaluated as part of that report. The freeboard in the flume does not influence the discharge capacity or freeboard of the canal or surge tower, and, therefore, any modifications to the flume to provide one foot of freeboard will be localized and will not affect the discharge capacity or freeboard of the canal or surge tower.

Based on the information, findings and conclusions above, an interim operating plan for Lake Waukewan has been produced. This interim operating plan will be utilized for the 2010 recreation season and the 2010 fall drawdown. During the recreational season (mid-May through November 1) the water level shall, insofar as meteorological conditions allow, be maintained at a level of 539.5. After the recreational season is completed (November 1), the water level shall, insofar as meteorological conditions allow, be gradually lowered to a level of 538.0.

During the 2010 recreational season DES will solicit public comments on this interim operating level, after which, a final operating level decision will be issued by DES.

Any person aggrieved by this decision may appeal to the Water Council by filing a Notice of Appeal in accordance with New Hampshire Code of Administrative Rules Chapter Env-WC 200 (Water Council Procedural Rules) within 30 days of the date of the decision.

Date: April 12, 2010

James W. Gallagher, Jr., P.E.
Chief Water Resources Engineer
Department of Environmental Services